Questions matter

Marking guidance

A-level Mathematics (7357)

A-level Further Mathematics (7367)

Introduction

Teachers have told us that they would like to learn more about how to mark like an examiner. This document aims to outline the fundamental aspects of the marking process. Our aspiration is that it will facilitate a greater understanding of how to apply an AQA mark scheme and improve confidence in awarding marks accurately.

This guidance is supplementary to the standard guidance given in all mark schemes. It supplements additional notes in the AS and A-level Maths Teaching Guidance and the A-level Further Maths Teaching guidance.

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Marking instructions and assessment objectives

The essential feature of any mark scheme is the marking instruction for each mark. Each instruction is linked to the assessment objective (AO) with the AO giving a clear focus for the mark.

Marking instructions are usually written to highlight the mathematical principle for which the mark should be awarded, often with evidence that would lead to the award of the mark. We do not try to list all possible evidence and, when in doubt, professional judgement should be used to decide whether the principle of the marking instruction is satisfied by the student's work.

Sometimes a marking instruction simply states the evidence that is required to award the mark.

Typical solutions

The typical solution is exactly what it says: a typical, correct solution. It is not the only solution. It is not necessarily the best possible or most efficient solution: it is usually a solution that students would give. It is not written side by side with the marking instructions, because that would suggest that all solutions need to follow the given order of the instructions, but they do not.

Answer given or not

Questions are never written as questions: they are always instructions to do something. They can be broadly categorised into two types:

1. The answer is given and the instruction is, for example, "Show..." or "Prove..."

   There must be correct work leading to that answer to award marks. When a numerical answer is required, the marking instruction will typically make it clear that an expression which evaluates to give the answer must be shown.

2. No answer is given and the instruction is, for example, "Find..." or "Calculate..."

   If the correct answer is obtained then full marks should be given, whether there is working or not, unless there is clearly incorrect working leading to that answer and in that case any correct working should be marked appropriately.

Fully justify your answer

This instruction can appear in questions of either of the two types above. The instruction "Show..." or "Prove..." already indicates the need for working leading to the answer. The "Fully justify..." command indicates the need for some justification or explanation that makes the mathematical argument complete.

Mark types and how to award them

B1

This requires correct work and is awarded independently of other marks wherever that correct work is found in a solution. If a question is only worth 1 mark this could be a B1 mark with no working required.

M1

A method mark requires evidence of correct method, but this does not require work to be free of errors. It is also possible to give an M1 later in a solution, even if earlier M marks have not been obtained. Sometimes the marking instruction for an M1 states "PI" which emphasises evidence which could "possibly imply" the M1 mark. This can happen if there are several approaches to solving a problem and the typical evidence for an M1 could be missing if a student adopts another approach from that stated in the marking instruction.

A1

It is not possible to award M0 A1 – if you see an answer that justifies the A1 then you would give the M1 too. An A mark will usually depend on the immediately preceding M mark. Typically, a single A1 mark is paired with an M1, but sometimes more than one A1 mark will be linked to the previous M1 mark.

E1

This is another independent mark, given for an explanation. Sometimes explanations are wordy, sometimes they can be entirely mathematical. This mark is usually linked to AO2.4, Explain their reasoning, but can also be linked to AO3.5a, AO3.5b, AO3.5c or AO2.2b.

R1

The reasoning mark is often linked to AO2.1 Construct rigorous mathematical arguments. We are careful to identify "rigorous" as referring to the argument, not the notation used to present this argument and thus marking instructions for R1 marks will often state "Completes a **reasoned** mathematical argument to show that..." to emphasise that if the reasoning is sound the mark should be given.

If, on the other hand, a marking instruction says "Completes a **rigorous** mathematical argument..." this indicates that the argument needs to be more precise in some way. For example, there might be a stipulation that many or most of the other marks must have been awarded to give the R1 mark.

Equations in a given form

If a question states that an equation is required in a particular form, eg $ax + by + c = 0$ we would allow any rearrangement of the terms on the left-hand side (LHS), eg $by + c + ax = 0$
We would also allow the equation to be written as $0 = ax + by + c$ and any rearrangement of terms on the right-hand side (RHS) would be accepted.
The same principle applies to answers given in the mark scheme either in the marking instruction or typical solution.
For example, if a marking instruction states "Obtains the correct equation" and the typical solution shows this to be $y = 3x^2 - 7x + 3$ we would accept any rearrangement of the terms on the RHS and we would accept $3x^2 - 7x + 3 = y$ with any rearrangement of terms on the LHS.
The standard abbreviation ACF (Any correct form) does not need to be stated to clarify the marking principles described in this section. ACF could be used if, for example, the required answer is the equation of a circle. An answer could be stated in the standard form as $(x-2)^2 + (y+1)^2 = 4$, but ACF would emphasise that this could be given in any other form: fully expanded, even if not simplified, partially expanded, etc.

Algebraic expressions in a given form

When a question states "Find an expression for..." then only the expression needs to be given and it can take various acceptable forms.

For example, a sequence is defined by $u_{n+1} = pu_n + 70$, where $u_1 = 400$ and p is a constant.
Find an expression, in terms of p, for u_2.
The answer does not have to be written as $u_2 = 400p + 70$, because the required expression is simply $400p + 70$

Students will often look at the structure given in the question, $pu_n + 70$, and decide that their answer must match this form, so they will write $p(400) + 70$, which is acceptable. However, $p400 + 70$ is not acceptable, because this is a non-standard algebraic representation. (Note that if a form like this was used in working, leading to a later correct answer, it could still be worth an M1 mark.)

Once again, the correct answer may be written with terms rearranged, eg $70 + 400p$
The standard abbreviation ACF (Any correct form) does not need to be stated to clarify the marking principles described in this section. ACF could be used if, for example, various correct factorised forms might be seen, such as $(x-3)(x+2)(x-4)$ being given as $(3-x)(x+2)(4-x)$ or $-(3-x)(x+2)(x-4)$ etc.

Rounding

Questions will often ask for answers to be given to a particular degree of accuracy. The purpose of making this request is usually to give students clarity in how to answer the question. However, accuracy and rounding are not often specifically assessed in AS and A-level Maths and Further Maths and it would usually be acceptable to give answers to greater accuracy than requested, including as exact values.

There is a risk that if an answer is given to less accuracy than required in a question that the examiner cannot be confident the question has been answered correctly. In such cases it might not be possible to award the mark. For example, in questions that require an approximation using a numerical method, an answer given to less accuracy than required could be obtained by another method and so could not be awarded a mark.
There are often technical issues arising from rounding and the use of previously rounded answers which require careful stipulation in the mark scheme of what answers are acceptable.

When marking a question where a rounded answer is required it is essential to be guided by the agreed mark scheme, not by the request in the question.

There are some standard instructions in mark schemes:

- AWRT means "anything which rounds to." For example, an answer is 2.356321... The question says, "Give your answer to 3 significant figures." We could say the answer is AWRT 2.36, so if a student writes 2.36 or the correct answer with more figures or something close to the correct answer, which nevertheless rounds to 2.36 then their answer is correct. There might seem to be a risk that an incorrect answer would be awarded marks, but if a "correct" answer comes from incorrect working it would not be given marks. If a "correct" answer is given from incorrect working which has not been written down, then we must give the benefit of the doubt to the student and award the marks.
- AWFW means "anything which falls within": this instruction may appear with a specified interval in which an answer lies, eg AWFW [0.0806, 0.807] or the interval itself may be given as an answer, eg P($X \leqslant 19$) = [0.806, 0.807].

Rounding in modelling questions

AO3.2a Interpret solutions to problems in their original context indicates that sometimes rounding matters when understanding how to interpret a solution. It is sensible to pay particular attention to correct rounding when answering a modelling question, because it might be important when considering the validity of the model.

Fractions, decimals and percentages

If there is no clear instruction in a question or the mark scheme that an answer must be given in a particular form, then a fraction, simplified or not, decimal (rounded or perhaps truncated) or percentage would be accepted.
The abbreviation OE (Or Equivalent) may be used to indicate that any equivalent representation of the answer is given the mark.

Exact forms

In questions requiring exact answers, if there is no specific form required, then any correct exact form is acceptable.

For example, if the required answer is $\frac{1}{2}e^{-2}$ then $0.5e^{-2}, \frac{1}{2e^2}$ are correct answers. However, an incomplete calculation such as $\frac{1}{2} \times e^{-2}$ would not be an acceptable answer.

Units

Many modelling questions require answers in context. Whilst it is always best to include the units for such answers, units are seldom required to obtain the mark and the marking instruction will state "Condone missing units."

Units are usually required when the mark is associated with *AO3.2a Interpret solutions to problems in their original context*.

For example, a question that states "Use the model to find the time it takes for the temperature to fall by 10 degrees, giving your answer to the nearest minute." with a required answer of, say, 70 minutes, could also have an acceptable answer of 1h 10 mins, but not 1.17 or 1.2 hours.

Identity or equation

We do not distinguish between an identity and equation when marking questions which require students to prove an identity.

Command words in marking instructions

Substitutes

We need explicit evidence that the student has shown substitution of values into the required algebraic expression. Sometimes the instruction will emphasise this by stating "substitutes explicitly." In practice, students may often substitute on a calculator.

For example, consider the question.
Show that $x-1$ is not a factor of $f(x) = x^3 - 5x^2 + 6x - 1$
A student might enter the algebraic expression in their calculator and obtain $f(1) = 1$.
They could then correctly conclude that since $f(1) \neq 0$, then, by the factor theorem, $x-1$ is not a factor of $f(x) = x^3 - 5x^2 + 6x - 1$.
If the marking instruction states "Substitutes $x = 1$ into $x^3 - 5x^2 + 6x - 1$" we would need to see $1^3 - 5 \times 1^2 + 6 \times 1 - 1$.
We might decide that this mark could be implied by $f(1) = 1$ so there would be an instruction saying, "PI by $f(1) = 1$."

Condone

Sometimes questions are more challenging than expected and senior examiners decide that answers which are not technically correct can be condoned in that question part. This does not mean that they will be condoned in the future.

Questions are often designed so that the first part is more accessible. For example, consider this question.

A has coordinates (–2, 1, 3) and the vector $\overrightarrow{AB} = \begin{bmatrix} 4 \\ -1 \\ k \end{bmatrix}$ Find the coordinates of *B*.

In the marking instruction we could decide to condone an answer given as a vector: more students will be awarded the mark.

For example, in a Mechanics question about connected particles which are not moving in the same direction, the following question could be asked: Explain how you have used the assumption that the string is inextensible.

The correct answer is that this assumption implies that the magnitude of the acceleration of each particle is equal. We could decide that the answer "the acceleration of each particle is equal" can be condoned, because we judge that so few students would refer to the magnitude that the mark would almost never be awarded.

Uses

We need to see evidence that a formula or equation, for example, has been used, not simply recalled or stated.
For example, a marking instruction could state "Uses $\cos^2 x + \sin^2 x \equiv 1$", perhaps when writing a trigonometric equation in terms of one trig function. We need to see the correct identity being used, although there might be an error in its use.

Recalls

This indicates that something must simply be written down. For example, the instruction "Recalls $\cos^2 x + \sin^2 x \equiv 1$", indicates that simply seeing the identity (or equation) gets the mark.

Obtains

This is the usual instruction for getting an answer. Remember that if the question asks for an answer that is not given, obtaining the right answer means full marks, unless there is incorrect working leading to that answer or unless there is a marking instruction to the contrary.

Deduces

This instruction is typically linked to AO2.2a and is usually linked to an R1 mark. There is not necessarily a need for any explicit argument leading to the deduction.

If you want to learn more

We have an on-demand e-learning Mark scheme guidance and application course available to access on our website.

If you'd be interested in joining our team of examiners then please check our website to see if there are any vacancies or to express your interest.